

# An overview of pressure ulcer risk assessment tools

## KEY WORDS

- ▶ Pressure ulcer
- ▶ Prevention
- ▶ Risk assessment
- ▶ Skin

Pressure ulcers are believed to largely be preventable, but in order to make best use of both human and physical resources, and maintain patient comfort and dignity, it is important to identify the people most at risk and deliver timely preventative care. Many 'tools' have been developed that purport to identify those who are most at risk; some of these are used generically across all patient groups, others are targeted to specific subgroups of patients; but all have some shortcomings. Clinical judgement should always be a key element of assessing a patient's risk but this can be difficult to articulate and document. Newer ways of identifying at-risk areas rather than at-risk patients are just starting to be developed and used.

Preventing pressure ulcers from occurring within any healthcare setting is high on everyone's agenda, as they impact significantly on patients' quality of life, morbidity and mortality, as well as resulting in increased length of stay and additional costs (National Institute for Health and Care Excellence [NICE], 2014a). In order to make best use of limited resources, risk assessment tools (RATs) or pressure ulcer risk assessment scores (PURAS) are widely used across all healthcare settings to help clearly identify patients prevention strategies should be targeted towards.

NICE (2014b) recommends that a validated tool is used to support clinical judgement when assessing risk and the international guidelines (National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance [NPUAP, EPUAP and PPIA], 2014) caution '*do not rely on a total risk assessment tools score alone as a basis for risk prevention ... subscales and other risk factors should be examined to guide risk-based planning*'.

There are a plethora of risk assessment tools available; some designed for almost generic use, others for specific populations such as those in critical care/intensive care units or paediatrics (Table 1). Equally, attempts have been made to elucidate risk factors specific to areas of

the body deemed to be at risk such as heels (Delmore et al, 2015).

There is much discussion around the utility of RATs; in a Cochrane review of RATs, Moore and Cowan (2014) concluded that there is no reliable evidence to suggest that use of structured systematic PURAS reduces the incidence of pressure ulcers. Samuwiro and Dowding (2013) suggest that asking nurses to spend a lot of time, energy and effort assessing risk may not be the best use of resources, given that they do not objectively measure the risk. Nationally and internationally, however, they remain an almost compulsory component of care. Perhaps the main challenge lies in the understanding of what a RAT does or how they are used.

## WHAT THE RAT DOES

The RAT is a collection of weighted factors believed to influence the patients' risk of developing pressure damage. However, many of the components of RATs are not predictive of pressure ulcer occurrence (Anthony et al, 2010; Moore and Cowan, 2014). A systematic review of the literature on risk factors (Coleman et al, 2013) identified 365 papers of which 54 met the eligibility criteria; from these it was possible to determine that myriad factors were believed to increase individual patient's risk, however,

**Table 1. Some examples of RATs for specific populations**

Population type	Tools available	Reference
Used generically	Waterlow Braden Norton Shape PURPOSE T	Waterlow, 2005 Bergstrom and Braden, 1992 Norton et al, 1975 Soppi et al, 2014 Nixon et al, 2015
Paediatrics	Braden Q Glamorgan PPUPET	Curley et al, 2003 Willock et al, 2007 Sterken et al, 2015
End of life/Hospice	Hunter's Hill	Chaplin 2000
Screening tools	Andersen PURPOSE T	McClemont et al, 1992 Nixon et al, 2015
Orthopaedics	PSPS	Lowthian, 1989
Community	Walsall	Chaloner and Franks, 2000
Intensive care	Cubbin COMHON Sunderland	Jackson, 1999 Fulbrook and Anderson, 2016 Lowery, 1995
Critical care	CALCULATE	Richardson and Barrow, 2015 Richardson and Straughan, 2015
Spinal cord injured	SCIPUS	Delparte et al, 2015

the risk factors that emerged most frequently as independent predictors of pressure ulcer development included three primary domains of:

- ▶▶ Mobility/activity
- ▶▶ Perfusion (including diabetes)
- ▶▶ Skin/pressure ulcer status.

Skin moisture, age, haematological measures, nutrition and general health status were also important, but did not emerge as frequently as the three main domains. Body temperature and immunity may be important but require further confirmatory research. There was limited evidence that either race or gender is important.

In addition to the multiple and frequently unsubstantiated risk factors, the importance of these components is often not accurately reflected by their range of values (Anthony et al, 2010); for example, it is unclear why in some RATs a female scores differently to a male or why scores for diabetes may vary between 4 and 6.

The predictive ability of any RAT is determined by using statistical tests that determine what percentage of patients the tool correctly identifies as being at risk (i.e. that patient goes on to develop a pressure ulcer) and also those that the tool correctly predict to be not at risk (i.e. they do not develop a pressure ulcer). However, this assumes that no care will be given which is not the case (Olshansky, 2014). Once risk is identified, preventative action must be triggered; allowing a patient to succumb to a known or imagined hazard would be morally unsupportable (Maylor, 2011).

**HOW RATs ARE USED**

In the reality of clinical practice there are many challenges associated with the use of RATs, for example, the categories included within the tools are frequently open to interpretation. Even in tools such as Braden where descriptors of the main risk factors are given, there can be discrepancies in the way individual clinicians interpret the discrete categories. Many studies investigate both the inter- and intra-rater reliability of the RATs to determine how open to interpretation the factors are (Kottner and Dassen (2010); Wang et al (2015); Fulbrook and Anderson (2016)).

In an attempt to improve the reliability, Choi and Kim (2013) reviewed clinical notes to better understand how nurses used the operational definitions in the activity parameter of the Braden tool. They give examples of nurses using phrases such as: ‘walks occasionally during the day but for short distances’ and ‘spends the majority of each shift in bed or chair’, which are probably common phrases — but when determining what they actually mean, could be interpreted and applied to the risk categories very differently.

In a busy clinical setting, complex RATs with multiple categories can frequently be poorly completed. Samuwiro and Dowding (2014) concluded that most nurses do not assess patients’ risk on admission, instead deferring assessment to the day after admission or even later. This is contrary to the guideline recommendations that stipulate assessment should be completed as soon as possible and at the maximum within 8 hours (NICE, 2014b). They also suggest that nurses prepared to manipulate a risk score in order to

ensure patients were eligible for a particular type of pressure-redistributing equipment. Johansen et al (2014), who compared assessment and preventative care in Ireland (where RATs are used) and Norway (where RATs are not used), found that staffing levels, a lack of time and staff competence hindered optimal documentation.

One of the frequently mentioned shortcomings of RATs is their presentation: they must be in a user-friendly format to encourage clinicians to use them. Kin et al (2014) developed a prototype mobile system called SAPPPIRE (Skin Assessment for Pressure Ulcer Prevention, an Integrated Recording Environment) for an android device to assist nurses with skin assessment and documentation at bedside. The device was designed to demonstrate: data documentation conforming to the relevant terminology standards, data exchange using Continuity of Care Records standard and smart display of patient data relevant to risk parameters to promote accurate pressure ulcer risk assessment with the Braden Scale. The electronic platform allowed them to refine criteria and offer multiple options via a touch screen platform to encourage accuracy. Unfortunately, they do not present data on actual clinical use.

Creehan and Brindle (2011) identified that staff frequently recorded a risk score in their documentation but failed to enact interventions to prevent pressure ulcer development. They decide to make the Braden scale come alive and embedded recommendations for care in each of the categories and subcategories. To provide nurses with immediate understanding of their patients' risk of skin breakdown, they used the traffic light system previously developed by the Royal Adelaide Hospital (2014) in Adelaide, Australia (*Figure 1*). As the Braden scale's subscores are listed from low risk (4) to high risk (1), so the colours change with each risk level, from green (low risk) through yellow to red (high risk). Illustrations are used alongside the colour-coded chart to assist understanding of which aspect of the patient's condition they're assessing. They modified the tool to include subcategory interventions — thus really guiding the care that needed to be delivered.

This thoughtful consideration of how nurses access and use tools makes the tools

considerably more user-friendly and therefore more likely to be used.

## ALTERNATIVES TO RATs

### Clinical judgement

Many studies identify that nurses also use their clinical judgement, frequently overriding the 'score' as determined by the RAT. This is perfectly acceptable; indeed, it is recommended in both the NICE (2014b) and NPUAP, EPUAP, PPPIA (2014) guidelines. Based on reflections of the methodological literature, a critical appraisal of available trials on this subject. Balzar et al (2013) conclude that there is no reliable evidence that RAT aided risk assessment is any better than clinical judgement in assessing risk. However, it can also be a further cause of differences; Balzar et al (2014) identified that nurses are likely to trade-off risk-enhancing conditions against factors they perceive are protective, for example, balancing risk factors with the patient's willingness and ability to participate in preventative care. They also identified divergence when assessing the risk related to some patient characteristics. They cited two conditions that were differently interpreted as both risk increasing and risk lowering (use of an indwelling urinary catheter and smoking). Two of the nurses in their study associated the presence of a catheter with increased risk, as it would be likely to hamper mobility; four regarded this as protective as it reduced the exposure of the skin to moisture. Three nurses identified the increased risk from smoking, based on its effects on circulation/perfusion. One, however, suggested this was a possible risk-reducing effect as many smokers are early mobilisers, being more motivated to walk due to their nicotine dependence.







Johansen et al (2014) concluded that the use or not of a RAT did not make any difference to the identification of at-risk patients, planning, initiation and evaluation of pressure ulcer prevention strategies.

### Skin assessment

Several alternatives to RATs have been proposed. Vanderwee and colleagues completed a randomised controlled trial comparing the use of the Braden scale to the presence of non-blanching

# BRADEN PRESSURE ULCER RISK ASSESSMENT

## ACT TO PREVENT PRESSURE ULCERS

<b>SENSORY PERCEPTION</b> Ability to respond meaningfully to pressure-related discomfort 	<b>NO IMPAIRMENT</b> Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.	<b>SLIGHTLY LIMITED</b> Responds to verbal commands but cannot always communicate discomfort or ask to be moved or turned OR has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.	<b>VERY LIMITED</b> Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness OR has a sensory impairment which limits the ability to feel pain or discomfort over 1/2 of body.	<b>COMPLETELY LIMITED</b> Unresponsive (does not moan, flinch, or grasp) to painful stimuli due to diminished level of consciousness or sedation OR limited ability to feel pain over most of body surface.	4 3 2 1 ADD TO TOTAL SCORE	
	<b>MOISTURE</b> Degree to which skin is exposed to moisture 	<b>RARELY MOIST</b> Skin is usually dry; linen only requires changing at routine intervals.	<b>OCCASIONALLY MOIST</b> Skin is occasionally moist, requiring an extra linen change approximately once a day.	<b>OFTEN MOIST</b> Skin is often but not always moist. Linen must be changed at least once a shift.	<b>CONSTANTLY MOIST</b> Skin is kept moist almost constantly by perspiration urine, etc. Dampness is detected every time patient is moved or turned.	4 3 2 1 ADD TO TOTAL SCORE
<b>ACTIVITY</b> Degree of physical activity 	<b>WALKS FREQUENTLY</b> Walks outside the room at least twice a day and inside room at least once every 2 hours during waking hours.	<b>WALKS OCCASIONALLY</b> Walks occasionally during day but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.	<b>CHAIRFAST</b> Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	<b>BEDFAST</b> Confined to bed	4 3 2 1 ADD TO TOTAL SCORE	
<b>MOBILITY</b> Ability to change and control body position 	<b>NO LIMITATIONS</b> Makes major and frequent changes in body or extremity position without assistance.	<b>SLIGHTLY LIMITED</b> Makes frequent though slight changes in body or extremity position independently.	<b>VERY LIMITED</b> Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	<b>COMPLETELY IMMOBILE</b> Does not make even slight changes in body or extremity position without assistance.	4 3 2 1 ADD TO TOTAL SCORE	
<b>NUTRITION</b> Usual food intake pattern NPO: Nothing by mouth. IV: Intravenously. TPN: Total parenteral nutrition. 	<b>EXCELLENT</b> Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.	<b>ADEQUATE</b> Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products) each day. Occasionally will refuse a meal, but will usually take a supplement if offered, OR is on a tube feeding or TPN regimen, which probably meets most of nutritional needs.	<b>PROBABLY INADEQUATE</b> Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only 3 servings or meat or dairy products per day. Occasionally will take a dietary supplement, OR receives less than optimum amount of liquid diet or tube feeding.	<b>VERY POOR</b> Never eats a complete meal. Rarely eats more than 1/3 of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement, OR is NPO and/or maintained on clear liquids or IV <sup>2</sup> for more than 5 days.	4 3 2 1 ADD TO TOTAL SCORE	
<b>FRICITION &amp; SHEAR</b> 	<b>NO APPARENT PROBLEM</b> Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair at all times.	<b>POTENTIAL PROBLEM</b> Moves feebly or requires minimum assistance. During a move, skin probably slides to some extent against sheets, chair, restraints, or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	<b>PROBLEM</b> Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures, or agitation leads to almost constant friction.	4 3 2 1 ADD TO TOTAL SCORE		
<b>RISK SCALE</b>	NONE 23 22 21 20 19	MILD 18 17 16 15	MODERATE 14 13	HIGH 12 11 10	SEVERE 9 8 7 6	<b>TOTAL SCORE</b> USE CHART ON LEFT TO DETERMINE YOUR PATIENT'S RISK
<b>EQUIPMENT</b>	No additional pressure support required	High specification foam mattress or static air overlay. Consider cushion for chair, Bedcradle/gooseneck	Dynamic air overlay, Dynamic air cushion Dynamic mattress Replacement or Low Air Loss			
<b>PRACTICE</b>	<ul style="list-style-type: none"> <li>Educate</li> <li>Weight-shifting, Skin inspection</li> <li>Evaluate on change of condition</li> </ul>	<ul style="list-style-type: none"> <li>Reposition</li> <li>Weight-shifting, Skin inspection</li> <li>Promote Activity</li> <li>Manage individual risk factors</li> <li>nutrition; shear; friction; continence</li> <li>Educate</li> <li>Evaluate on change of condition</li> </ul>	<b>ALL PLUS</b> <ul style="list-style-type: none"> <li>Supplement with small positional shifts</li> <li>Seating/posture assessment</li> <li>Nutritional assessment</li> <li>Educate</li> <li>Evaluate on change of condition</li> </ul>			

Reference: "The Braden Scale of Predicting Pressure Sore Risk" Bergstrom, N; Braden, B et al. Nursing Research 1987 Vol 36 No 4 pp205-210  
 Issued by Royal Adelaide Hospital Staff Development Department in conjunction with South Australian Quality Council Pressure Ulcer Prevention Practices - Integration of Evidence.

Figure 1. The Braden Traffic light tool (amended from Royal Adelaide Hospital, Australia)

erythema (NBE) as the trigger to instigate preventative equipment (Vanderwee et al, 2007a). In this large study (1,671 patients), the pressure ulcer incidence (grades 2–4) was not significantly different between the experimental (6.8%) and control groups (6.7%), however, in the Braden group, twice as many patients (32%) received preventative equipment with compared with 16% in the NBE group – a significant cost difference. However, the study acknowledges that there were no patients with dark skin included and that NBE is much more difficult to distinguish in those patients. McReath et al (2016) studied the use of the Munsell colour chart to identify damage (NBE) on skin of different colour tones and concluded that as populations become increasingly multiracial, tools such as the Munsell colour chart could become essential in assessing accurate skin colour baseline measurements, which are imperative assessments for detection of NBE development in patients with darker skin tones.

Akins et al (2016) studied the use of ultrasound as an imaging modality for acquiring measurements of anatomical features associated with deep tissue injury (DTI) in six participants (two controls, two with recent SCI and two with long-term SCI). They concluded that given the reliability and ability of ultrasound measurements to identify high-risk anatomies, as well as the cost effectiveness and availability, these show promise for use in future development of a patient-specific, bedside, biomechanical risk assessment tool to guide clinicians in appropriate interventions to prevent DTI.

Moore et al (2016) reviewed the literature on the use of a sub-epidermal moisture (SEM) scanner, suggesting that it can detect pressure damage some 3–10 days prior to damage being observed on the skin. Guihan et al (2012) assessed the SEM scanner in 34 SCI veterans and demonstrated the ability of the scanner to detect differences in the skin suggestive of early pressure damage. This is supported by O'Brien (2015), who used the scanner to compare with nurses' skin assessment in 47 patients. Of the 47 patients, 34% ( $n=16$ ) exhibited sustained elevated deviation in SEM levels and 100% went on to develop visual signs of

pressure ulceration. However, more importantly, the scanner identified damage, on average, 3.9 days earlier than nurses' visual assessment.

### OTHER TOOLS

Some areas suggest alternatives to PURATs; for example, Hyun et al (2014) propose the use of body mass index (BMI) in patients within an intensive care unit. The incidence of pressure ulcers in the underweight, normal weight, obese, and extremely obese groups was 8.6%, 5.5%, 2.8% and 9.9%, respectively. When both the score on the Braden scale and the BMI were predictive of pressure ulcers, extremely obese patients were about two times more likely to experience an ulcer than were normal weight patients.

Dijkstra et al (2015) evaluated pressure ulcer risk using the Care Dependency Scale (CDS) for patients receiving home care or who were admitted to a residential or nursing home. They found that CDS items 'body posture' (home care), 'getting dressed and undressed' (residential homes) and 'mobility' (nursing homes) were the most significant variables which affect pressure ulcer occurrence. They concluded that the CDS was able to distinguish between patients at risk for pressure ulcer development and those not at risk in both home care and residential care settings. In nursing homes, however, the usefulness of the CDS for pressure ulcer detection was limited. They suggest that as the CDS is already used as a general assessment tool and appears to have the ability to identify risk, the use of a single (rather than two) risk assessment tools would simplify processes and increase the use of the tool.

Similarly, Carreau et al (2015) compared the use of the minimum data set 2.0 (MDS 2.0) to the Braden score in a complex continuing care setting using a retrospective chart review of 51 patients. They concluded that the MDS 2.0 PURS may be an alternative risk assessment tool option that utilises mandatory collected data, reduces workload duplication, and would generate a resident assessment protocol, when indicated, in complex continuing care.

### RISK ASSESSMENT AND PREVENTION

Perhaps one of the biggest challenges for the RATs

is that a tool does not prevent a pressure ulcer — it is the care that is planned and implemented following the assessment that prevents the pressure ulcer occurring. Anthony et al (2010) state quite clearly that there is no evidence that the use of RATs reduces pressure ulcer incidence. Vanderwee et al (2007a) showed that there was a complete disconnect between risk assessment and preventative interventions. In their systematic review of nurses' judgements and decision-making, Samuriwo and Dowding (2014) identified poor use of the risk assessment to underpin preventative plans and decision-making. However, Maylor (2011) presented a slightly different view, suggesting that is a false assumption that people act effectively on the basis of what they know and that risk can always be reduced. In order to trigger action, nurses must both believe that their intervention will make a difference and that it is within their power to change what is done (Maylor and Torrence, 1999). In many cases, the plan of prevention is overly simplistic and is based on what nurses have access to and feel they can control — frequently the use of specialist mattresses and cushions, skin care and a repositioning regimen. However, these simple actions form the basis of the SKIN (or SSKIN) bundles, and if implemented consistently alongside nutritional care and management of incontinence, should go some considerable way to help prevent pressure ulcers occurring. Perhaps if the RAT focused on fewer but more crucial risk factors, it would be easier to direct more appropriate care.

The PURPOSE T risk assessment tool (Nixon, 2015) was developed based on a systematic literature review and Delphi process: it includes only six key risk factors:

- ▶▶ Analysis of independent movement
- ▶▶ Sensory perception and response
- ▶▶ Moisture due to perspiration
- ▶▶ Urine, faeces or exudate
- ▶▶ Perfusion, nutrition
- ▶▶ The presence of diabetes.

There are no numbers to be added up, the higher risk in each category is colour-coded. Crucially, there is a short screening process for patients deemed not to be currently at risk and also a plan of action generated from the risk. It uses the same

traffic light system used in the Royal Adelaide poster to make it quick and easy to understand.

## CONCLUSION

While many RATs exist, it appears that no single one is universally liked or used and determining the reliability or validity of the tools is complicated by the need to intervene. There are many flaws associated with these tools including the fact that use of a risk assessment tool may not improve patient outcomes (Balzar et al 2013; Samuriwo and Dowding, 2014). The missing link between assessment, care planning and provision is a fundamental flaw. Johansen et al (2014) suggest that the practice of risk assessment should be re-evaluated. Nurses should be encouraged to use a combination of clinical judgement, information they have collected from other tools and risk assessment to develop a more focused assessment that leads to a good plan of care. Commissioners of healthcare may wish to focus on encouraging the development and delivery of plans of care rather than completion of RATs. **WUK**

## REFERENCES

- Akins JS, Vallely JJ, Karg PE et al (2016) Feasibility of freehand ultrasound to measure anatomical features associated with deep tissue injury risk. *Med Eng Phys pii: S1350-4533(16):30103-5*
- Anthony D, Papanikolaou P, Parboteeah S, Saleh M (2010) Do risk assessment scales for pressure ulcers work? *J Tissue Viability* 19(4): 132-6
- Balzar K, Kopke D, Luhmann D et al (2013) Designing trials for pressure ulcer risk assessment research: Methodological challenges. *Int J Nurs Stud* 50(8): 1136-50
- Balzar K, Kremer L, Junghans A et al (2014) What patient characteristics guide nurses' clinical judgement on pressure ulcer risk? A mixed methods study. *Int J Nurs Stud* 51(5): 703-16
- Bergstrom N, Braden B (1992) A prospective study of pressure sore risk among institutionalized elderly. *J Am Geriatr Soc* 40(8): 747-58
- Carreau L, Niezgodna H, Trainor A et al (2015) Pilot study compares scores of the Resident Assessment Instrument Minimum Data Set version 2.0 (MDS 2.0) pressure ulcer risk assessment scale with the Braden pressure ulcer risk assessment for patients in complex continuing care. *Adv Skin Wound Care* 28(1): 28-33
- Chaloner DM, Franks PJ (2000) Validity of the Walsall Community Pressure Sore Risk Calculator. *Br J Community Nurs* 5(6): 266, 268, 270, 272-6
- Chaplin J (2000) Pressure sore risk assessment in palliative care. *J Tissue Viability* 10(1): 27-31
- Choi J, Kim H (2013) Enhancement of decision rules to increase generalisability and performance of the rule - based system assessing risk for pressure ulcer. *Appl Clin Inform* 4(2): 251-66
- Coleman S, Gorecki C, Nelson EA et al (2013) Patient risk factors for pressure ulcer development: systematic review. *Int J Nurs Stud* 50(7): 974-1003
- Creehan MS, Brindle CT (2011) Stoplight system for pressure ulcer risk assessment. *Nursing* 41(9): 67, quiz 68

- Curley MAQ, Razmus IS, Roberts KE, Wypij D (2003) Predicting pressure ulcer risk in pediatric patients: the Braden Q Scale. *Nurs Res* 52(1): 22e–33
- Delmore B, Lebovits S, Suggs B et al (2015) Risk factors associated with heel pressure ulcers in hospitalized patients. *J Wound Ostomy Continence Nurs* 42(3): 242–8
- Delparte JJ, Scovil CY, Flett HM et al (2015) Psychometric Properties of the Spinal Cord Injury Pressure Ulcer Scale (SCIPUS) for Pressure Ulcer Risk Assessment During Inpatient Rehabilitation. *Arch Phys Med Rehabil* 96(11): 1980–5
- Dijkstra A, Kazimier H, Halfens JG (2015) Using the care dependency scale for identifying patients at risk for pressure ulcer. *J Adv Nurs* 71(11): 2529–39
- Fulbrook P, Anderson A (2016) Pressure injury risk assessment in intensive care: comparison of inter-rater reliability of the COMHON (Conscious level, Mobility, Haemodynamics, Oxygenation, Nutrition) Index with three scales. *J Adv Nurs* 72(3): 680–92
- Guihan M, Bates-Jensen BM, Chun S et al (2012) Assessing the feasibility of sub epidermal moisture to predict erythema and stage 1 pressure ulcers in persons with spinal cord injury: a pilot study. *J Spinal Cord Med* 35(1) 46–52
- Hyun BS, Li X, Vermillion B, Newton C et al (2014) Body mass index and pressure ulcers: Improved predictability of pressure ulcers in intensive care patients. *Am J Crit Care* 23(6): 494–500
- Jackson C (1999) The revised Jackson/Cubbin Pressure Area Risk Calculator. *Intensive Crit Care Nurs* 15(3): 169–75
- Johansen E, Moore Z, van Etten M, Strapp H (2014) Pressure ulcer risk assessment and prevention: What difference does a risk scale make? A comparison between Norway and Ireland. *J Wound Care* 23(7) 369–78
- Kin H, Chung H, Wang S et al (2014) SAPPiRE: a prototype mobile tool for pressure ulcer risk assessment. *Stud Health Technol Inform* 201: 433–40
- Kottner J, Dassen T (2010) Pressure ulcer risk assessment in critical care: interrater reliability and validity studies of the Braden and Waterlow scales and subjective ratings in two intensive care units. *Int J Nurs Stud* 47(6): 671–7. doi: 10.1016/j.ijnurstu.2009.11.005. Epub 2009 Dec 8.
- Lowery MT (1995) A pressure sore risk calculator for intensive care patients: 'the Sunderland experience'. *Intensive Crit Care Nurs* 11(6): 344–53
- Lowthian P (1989) Identifying and protecting patients who may get pressure sores. *Nurs Stand* 4(4): 26–9
- Maylor M (2011) Hazard avoidance: more sensible than risk assessment? *Br J Nurs* 20(15): S36
- Maylor M, Torrence C (1999) Pressure sore survey Part 3: Locus of control. *J Wound Care* 8(3): 101–5
- McClemont E, Woodcock N, Oliver S et al (1992) The Lincoln experience – Part 1. *J Tissue Viability* 2(4) 114–8
- McReath HE, Bates-Jensen BM, Nakagami G et al (2016) Use of Munsell color charts to measure skin tone objectively in nursing home residents at risk for pressure ulcer development. *J Adv Nurs* 72(9): 2077–85
- Moore ZEH, Cowman S (2014) Risk assessment tools for the prevention of pressure ulcers. *Cochrane Database Syst Rev* (2): CD006471. doi: 10.1002/14651858.CD006471.pub3
- Moore Z, Paton D, Rhodes SL, O'Connor T (2016) Subepidermal moisture (SEM) and bioimpedance: a literature review of a novel method for early detection of pressure induced tissue damage (pressure ulcers) *Int Wound J* doi: 10.1111/iwj.12604
- National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance (2014) *Prevention and Treatment of Pressure Ulcers: Quick Reference Guide*. Available at: <http://www.npuap.org/wp-content/uploads/2014/08/Updated-10-16-14-Quick-Reference-Guide-DIGITAL-NPUAP-EPUAP-PPPIA-16Oct2014.pdf> (accessed 04.08.2016)
- National Institute for Health and Care Excellence (2014a) *Costing Statement: Pressure Ulcers Implementing the NICE guideline on pressure ulcers (CG179)*. Available at: <https://www.nice.org.uk/guidance/cg179/resources/costing-statement-248688109> (accessed 04.08.2016)
- National Institute for Health and Care Excellence (2014b) *Pressure Ulcers: Prevention and Management NICE guidelines [CG179]*. Available at: <https://www.nice.org.uk/guidance/cg179> (accessed 04.08.2016)
- Norton D, McLaren R, Exton Smith A (1975) *An Investigation of Geriatric Nursing Problems in Hospital*. Churchill Livingstone, Edinburgh
- Nixon J, Nelson EA, Rutherford C et al (2015) Pressure Ulcer Programme Of reSearch (PURPOSE): using mixed methods (systematic reviews, prospective cohort, case study, consensus and psychometrics) to identify patient and organisational risk, develop a risk assessment tool and patient-reported outcome Quality of Life and Health Utility measures. Southampton (UK): NIHR Journals Library, Programme Grants for Applied Research
- O'Brien J (2015) *An Investigation of the Accuracy of Early Pressure Ulcer Damage Assessment Using Sub Epidermal Moisture Measurement versus Nurses' Visual Skin Assessment*. Poster submitted to EPUAP. Available at: <http://bruinbiometrics.com/en/sem/resources#research-publications> (accessed 04.08.2016)
- Olshansky N (2014) Should we eliminate the word "predictability" when discussing pressure ulcer risk assessment scales? *Journal of Wound, Ostomy and Continence Nursing* 41(3): 211
- PURPOSE T available from [https://xforms.leeds.ac.uk/forms/form/465/en/accessing\\_purpose\\_t\\_and\\_pupps\\_resources](https://xforms.leeds.ac.uk/forms/form/465/en/accessing_purpose_t_and_pupps_resources)
- Richardson A, Barrow I (2015) Part 1: Pressure ulcer assessment - the development of Critical Care Pressure Ulcer Assessment Tool made Easy (CALCULATE). *Nurs Crit Care* 20(6): 308–14
- Richardson A, Straughan C (2015) Part 2: pressure ulcer assessment: implementation and revision of CALCULATE. *Nurs Crit Care* 20(6): 315–21
- Royal Adelaide Hospital (2010) *Braden Pressure Ulcer Risk Assessment. Act to Prevent Pressure Ulcers*. Available at: <http://www.sahealth.sa.gov.au/wps/wcm/connect/a1b9c480438d079a9d7bdfbc736a4e18/2010maybradenriskassess.pdf?MOD=AJPERES&CACHEID=a1b9c480438d079a9d7bdfbc736a4e18> (accessed 04.08.2016)
- Samuriwo R, Dowding D (2014) Nurses' pressure ulcer related judgements and decisions in clinical practice: A systematic review. *International Journal of Nursing Studies* 51(12): 1667–85
- Soppi ET, Iivanainen AK, Korhonen PA (2014) Concordance of Shape Risk Scale, a new pressure ulcer risk tool, with Braden Scale. *Int Wound J* 11(6): 611–5
- Sterken DJ, Mooney J, Ropele D et al (2015) Become the PPUPET Master: Mastering Pressure Ulcer Risk Assessment With the Pediatric Pressure Ulcer Prediction and Evaluation Tool (PPUPET). *J Pediatr Nurs* 30(4): 598–610
- Vanderwee K, Grypdonck M, Defloor T (2007a) Non blanchable erythema as an indicator for the need for pressure ulcer prevention: a randomized – controlled trial. *J Clin Nurs* 16(2): 325–35
- Vanderwee K, Clark M, Dealey C et al (2007b) Pressure ulcer prevalence in Europe: a pilot study. *Journal of Eval Clin Pract* 13(2): 227–35
- Wang LH, Chen HL, Yan HY et al (2015) Inter-rater reliability of three most commonly used pressure ulcer risk assessment scales in clinical practice. *Int Wound J* 12(5): 590–4
- Waterlow J (2005) *Waterlow Score Card*. Available at: <http://www.judy-waterlow.co.uk/the-waterlow-score-card.htm> (accessed 04.08.2016)
- Willcock J, Baharestani M, Anthony DM (2007) The development of the Glamorgan paediatric pressure ulcer risk assessment scale. *Journal of Children's and Young People's Nursing* 15(5): 211e8